A DESCRIPTION

OF

CERTAIN DRY PROCESSES

IN

PHOTOGRAPHY,

SPECIALLY ADAPTED TO THE USE OF THE TOURIST,

WITH

SUPPLEMENTARY NOTICE OF PLANS

USEFUL TO THE SCIENTIFIC TRAVELLER

AND MISSIONARY.

By GEORGE KEMP, M.D.,

St. Peter's College, Cambridge, Fellow of the Cambridge Philosophical Society.

LONDON:
J. W. DAVIES, 54, PRINCES STREET, LEICESTER SQUARE.

LIVERPOOL:
HENRY GREENWOOD, 32, CASTLE STREET.

1863.

PREFACE.

THE contents of this pamphlet may be regarded as a portion of a research, instituted more than three years ago, for the purpose of investigating the nature of the molecular changes which occur in some of the more obscure departments of photography, and pursued, from time to time, in connexion with the practice of the art as an attractive amusement. Nothing was further from the writer's thoughts at the time than obtruding himself on the public in connexion with a subject, which, from the complicity of its theoretical details and vast amount of experience required in its manipulations, cannot be entered upon by an amateur without feelings of diffidence; this will, he trusts, be received as an apology for the homeliness of the extracts from his notes, registered at the time of making the experiments alluded to, and which possess sufficient internal evidence of their being merely intended for private reference.

It was not without a feeling of self-congratulation that, in process of time, certain plans unfolded themselves by which the writer was enabled to take negative views of objects with comparative certainty, and, by availing himself of the antecedent labours of others, to work them out in a manner that was not perhaps originally contemplated. After due consideration, and at the request of many high authorities on the subject, he has now ventured to bring together and publish them, in the hope that others may derive as much gratification from the adoption of the methods suggested for practice as he has himself.

The rapidly advancing season has, also, compelled him to hurry on the publication, and many interesting facts have

been omitted, which it is desirable to confirm by additional experiments; so far as the theoretical department of the research is concerned, it could not with propriety be introduced into this pamphlet, to say nothing of the incompleteness in which it stands at present. A research, indeed, can never be said to be finished; for when the student of nature enters upon a path of specific enquiry, however well he may define the limits of his investigation, cognate branches are sure to present themselves, without some knowledge of which his results must be deficient and obscure.

As photography is a pre-eminently practical art, appealing at every step to the senses, it will at once be acknowledged that the mere narration of the various processes connected with it is incomplete without illustration in the form of results obtained; from the nature of the case, this can only be done by depositing such results with some institution to which any inquirer may refer for information; and the writer proposes, at his earliest leisure, to forward negatives of each of the processes alluded to to one or two societies, with this end in view; indeed, in a certain sense, he feels bound to do so, as he cannot enter into private correspondence on the subject, excepting with personal friends.

The *rationale* of the dry processes generally will, it is believed, be deprived of much of its obscurity by recognising the principles laid down at the conclusion of Chapter I.; it is obvious indeed that in all inquiries of this nature, if we can but determine general laws, the knowledge of the extent of their operation, and the phenomena arising therefrom becomes a mere question of *time* and *work*.

G. K.

Hereford, May 20th, 1863.

INTRODUCTION.

THE interest with which any remarks on the various methods proposed for the production of the photographic image by means of what are usually denominated dry processes are received, and the anxiety to become acquainted with any accession hinted at in the journals specially appropriated to heliographic subjects, at once prove that the numerous plans already published have not practically justified the expectations of those who have adopted them, that a requirement still exists, and that any process of a dry nature which will at all approximate to the wet collodion processes in certainty, perfection of detail, and rapidity of action, will be valued and extensively practised.

Nor let it be supposed that the writer makes these remarks in a condemnatory manner, or with the slightest disparagement of the labours which have preceded the researches which form the subject of this memoir; on the contrary, having practised all the dry processes to which he could by any means obtain access, he is deeply sensible of the gratitude due to those who introduced these processes, and, notwithstanding opposition and most unmerited ridicule, pursued their course to a practical issue in the production of pictures of the utmost perfection, leaving the conviction on every candid mind that it only needed the experience and tact of the originators to produce equally attractive results.

It must, however, be conceded that in most of these processes, from one cause or other, failures of a very unaccountable kind have happened, not merely to the novice and unpractised in the art of photography—for this must occur with any process—but to those who, long habituated to the manipulations of the art, are fully capable of estimating its requirements in the way of cleanly and precise operative detail.

A remarkable instance of this occurred a few years ago in the case of two operators with the collodio-albumen, then called the Taupenôt, process.

The one of these was a teacher of photography of justly-earned celebrity, a great advocate of the process, who had even compiled a manual for the guidance of students; the other, a well-known amateur, distinguished for his success in photography and the fastidious care with which he carried on its various operations. A tour in different directions was made by each; in the former case, where we must suppose that every precaution was taken, the result was a signal and of course most annoying failure. The latter, out of forty plates, brought home thirty-nine excellent negatives, the fortieth plate having been broken by an accident in travelling.

The vast amount of experience which has been acquired since that period, and recorded in the photographic journals by disinterested and independent observers, has done much to explain many anomalies which mystified the original labourers in this field of inquiry, and the writer confidently hopes that the observations in this little work may contribute to the removal of others; but still, much research and expe-

rimental labour must yet be expended before the subtleties of this *pleasing*, and, as it is doubtless intended to be, most *useful* practical art may be fully unravelled: nor, considering the circumstances of the case, can it be otherwise.

The mind of research in photography, as in organic chemistry, has to deal not so much with *masses* of matter as with the veriest germs, the *molecules* of physical existence, but, for the most part, under totally different conditions.

In searching out the causes which influence the marvellous changes constantly taking place in organised bodies, and their issue in the performance of the functions to which they are respectively appointed, the chemical philosopher views these molecules in a state of actual movement. In the phenomena, however, which more immediately concern the photographer, the molecules of matter are in a state of rest, but in such wise that the slightest of many known disturbing forces immediately sets them in motion, and determines the production of new aggregate forms. The iodide of silver, for instance, in the collodion film, suddenly exposed to the influence of light, and then returned to darkness, remains to all appearance iodide of silver still; touch it, however, with a suitable developer, and immediately its molecular structure is broken up, and new physical forms determined, so that, in a certain sense, we may consider the molecules in the respective cases as in a dynamical or statical condition, and herein it would appear the limits of inquiry into the rapidity of luminary action on the photographic film are reached. A certain

amount of light stimulus is required to impress the image of an object on the film: if *insufficient*, no amount of development can give an harmonious picture; but, even when impressed, the successful production of the image in a visible form will be greatly influenced by the means adopted for its development.

Let the conditions once be determined by which the molecules of the iodide of silver can be placed at rest, indeed, but in an infinitely delicate poise between rest and motion; by which also, when motion has been elicited, it can be submitted to control, and the problem of instantaneous photography, whether by dry or wet processes, will be solved.

CHAPTER I.

GENERAL OBSERVATIONS ON THE PRINCIPAL DRY PROCESSES OF PHOTOGRAPHY—UNMERITED DEPRECIATION OF THE TALBOTYPE PROCESS AS ADAPTED TO THE REQUIREMENTS OF THE AMATEUR TOURIST—THE DRY PROCESSES ALREADY PROPOSED MORE CERTAIN THAN GENERALLY ADMITTED, WITH CAUSES OF FAILURE—CHARACTER OF NEGATIVE REQUIRED — ALLUSION TO ATMOSPHERIC INFLUENCES, WITH ILLUSTRATION—CERTAIN PRECAUTIONS NECESSARY IN THE PREPARATION OF ALL DRY PLATES, WHICH ARE REFERRED TO TWO CLASSES.

THE wonderful discovery and introduction of the collodion film, as a vehicle for the sensitised iodide of silver, by Archer, soon led to the conviction that if the sensitised plate could be retained in a condition for receiving an illuminated impression, even for a few hours and at a sacrifice of some degree of its sensitiveness, the sphere of its usefulness would be much enlarged, and to effect this object various methods were brought forward.

The cause of the depreciation of the sensitive plate was well known; a concentrated solution of nitrate of silver dissolves, practically speaking, the iodide of silver, and the main source of sensitiveness is at the same time destroyed. To obviate this, the solutions of certain deliquescent salts, such as the nitrate of magnesia, were introduced as a coating, and thus a weak solution of nitrate of silver was evenly retained

on the surface of the plate: a more convenient method was about the same time introduced by Mr. Shadbolt in the form of honey reduced to a semi-fluid state by means of distilled water, and this method, although apparently seldom used at present, offers an important resource to the practical photographer. It soon became apparent, however, that a great improvement would arise from producing plates actually dry; the immunity from particles of dust, and the increased hardness of the film, rendering it less exposed to injury in travelling. In the course of experiment by various persons engaged in the same line of research, gum, albumen, gelatine and its analogue, meta-gelatine, with many other substances, were fallen upon, proving sufficiently the much greater superiority of the respective dry processes to those of paper; still, however, leaving much to be desired and hoped for. The comparative slowness of action of these plates compared with wet collodion, the different stages of preparation with risks attendant on each, and, when albumen was employed as a vehicle for a new layer of iodides and bromides, to be resensitised in a separate bath, the rapid discolouration of the bath rendered these methods repulsive to the operator, and, in combination with many other disadvantages to the practical photographer, dry processes lost favour, and tent operations, with the usual wet collodion plates, supplied their use. Unfortunately, the amateur tourist, to whom time and a compact arrangement of travelling apparatus are of the last importance, was thus excluded from the enjoyment of the art, and the paper processes, which would in many respects have supplied the place of the more perfect collodion

process, became so depreciated that the amateur considered them unworthy of practice—a great mistake ; for, independently of the really excellent results which have and may be produced by their means, the steady and systematic working out of the Talbotype process is far more adapted to the initiation of the student into the leading principles of photography than the collodion process, and the adept in this paper method will enter upon the more perfect collodion process with some confidence and a full appreciation of the great nicety, both with respect to cleanliness and manipulation, on which the successful practice of the art depends.

To return, however, from this digression. Having alluded to the albumen processes, it should have been mentioned that the resensitising of the albumen is unnecessary, as it was discovered that the mere pouring of diluted albumen on the washed collodion film was sufficient for its preservation in a sensitive state, and this, denominated the Fothergill, is, for the amateur, one of the best, if not the best, of those preservative processes in which this class of animal fluids called proteine compounds is employed.

As a general remark it may be stated that most, if not all, of the dry processes above alluded to are more certain and capable of giving far better results than generally supposed; the fact is that they have been employed principally by amateurs, and, in many cases, by those who have not laboured in the higher department of chemical research, organic chemistry, and have not in consequence estimated the delicate nature of the changes which take place in the simplest operations of photography, far less recognised the multiplication

of sources of error in each one of the numerous stages necessarily involved in the most easily prepared plates, such for instance as those of Major Russell's excellent and certain tannin process. The evil has been much increased by not keeping to one plan of operation, and working it out to its utmost practicable limits; any proved dry process may by such means be pressed into the amateur's service. It may, indeed, require long exposure, slow development, and then look very shabby by the side of the pre-eminently beautiful works of Bedford or Wilson; and these distinguished artists have doubtless met with many a disappointment, many a failure, much hard and tiresome toil in working before they succeeded in producing the types they have done for their successors; still the result obtained will be *truthful* representations of scenes and objects amply repaying the labour bestowed upon them. Errors of another kind are also constantly made in the all-important developing stage of operations. Through a sanguine but fruitless attempt to fall into a royal road to photographic success, every new suggestion is eagerly snapped at, salts of iron are applied where only pyrogallic acid, or even the old but valuable gallic acid, suits the case, the unfortunate plate is fumed with ammonia, treated with formic acid, &c., all very valuable resources to the experienced photographer, but dangerous appliances when used empirically without a knowledge of the theoretical principles which adapt them to their respective cases; and, to complete disasters, when the image has been well brought out it is more rapidly expunged by cyanide of potassium where hyposulphite of soda is specially directed and can

alone be safely used. It is not, however, the mere fact of producing an image which is aimed at in a negative by any given dry process, the *character* of the negative as to capability of resisting light is of primary importance; this fact is well recognised in the moist process, and the practised eye will at once select a good printing negative from others which appear much darker and promise to the uniniated better results. The same fact holds good and perhaps with greater force in dry photographic plates, and the amount of actinic resistance possessed by some of these processes in apparently weak negatives is very striking; the misfortune, however, is this—that in most cases insensitiveness to impression in the camera is the general character of such. Thus, for instance, in the well known collodio-albumen process which stands very high in the list of preservative plans, immediately the details of the picture are well out, no apprehension need be entertained as to its printing capacity; to go on developing after this point has been attained, is only needlessly to risk damaging the film. In these plates the principal point to be aimed at is to give them abundant exposure, and although various methods have been published for more rapidly and indeed, as it is asserted, instantaneously bringing out the image from almost instantaneous exposure, the amateur tourist will not be wise to risk his negatives on the faith of what may after all be limited experience under exceptional conditions. There are many other methods which give far more rapid results than that alluded to; but, however convenient they may be in this respect, and although the amount of detail may be all that can

be desired, few can be compared to that process for the reliableness of the negative in its printing capacity.

Of course the writer alludes merely to those methods which are published; dry plates are now extensively sold as a commercial transaction; but if they entirely met the views of the photographic public in rapidity of action, certainty of operation, actinic resistance and economy, no anxiety would be felt for any fresh hints on the subject, and the writer might save himself the trouble of adding another line: the matter, in fact, would no longer be a subject for research but a case decided.

Certain points with reference to atmospheric conditions, also, will not be considered unworthy of attention; and the following summary remarks are offered, principally with the view of eliciting further observation. It must have frequently occurred to the tourist, especially employing dry plates, that on certain brilliant days, when he may have been fearful that he has over-exposed his plates, the results in the operating room prove that, on the contrary, sufficient time has not been given in the camera. It has long been known, and recorded by high authorities, that fine sunny days, with cloudless skies, are by no means the most favourable for photographic work; but this is not exactly the state of atmosphere alluded to, and the precise meaning of the writer may perhaps be better ascertained by an instance.

Last month (April 20th) a few plates, prepared as described in the sequel, were taken out on a tour to a secluded spot in Monmouthshire, Llanthony Abbey; the day broke loweringly, but, as the plates alluded to

are very good servants in cloudy weather, and as the general character of certain mountain scenery is more faithfully depicted in such weather, the trip was not postponed. Arriving at the Llanvihangel Station, the nearest point by rail to the Abbey, rain began to fall; but, as the writer has obtained capital negatives under shelter of an umbrella, forward was the order of the day, which, as it advanced, cleared up charmingly, and, long before the proposed point was reached, nothing remained but a few clouds capping the Scyrrid Vach, with here and there a cirro-stratus floating upon the azure blue. The little wind there was blew from the N. E., and, when we came upon the venerable pile, although every crevice and projection stood out in bold relief, and the abbey was in fact beautifully illuminated, former experience indicated the necessity of longer exposure than usual; forty-five seconds therefore were given to three of the four plates taken out, and seventy to the fourth, which took in the northern side of the ruin. On returning to develope in the evening, it was found that all the plates, although good negatives were obtained with appropriate treatment, would have been better for ten seconds' more exposure; and, taking all circumstances into consideration, the writer suggested to his companion the probability of the wind chopping round to the S. W., with a cyclonic storm, which, as is well known, took place on the following evening, producing great disasters on the coast. This is but one of many instances of a similar nature which have been observed, and it seems by no means improbable that the condition of the atmosphere in respect of actinism may become an

important element in meteorological observations; at any rate, no great extra trouble would be expended on taking an occasional note on the subject, and thus photography may in this, as it has, in other ways, become no mean accessory to the advancement of physical science.

The time of year, too, requires consideration; and on this point much remains to be done in the way of research. It has long been known that great variety of effects are produced in different months and at different hours of the day, and the fact is registered in the *Photographic News Almanac* as a guide to be referred to in practice; indeed, it will be observed in the sequel, that methods which gave excellent results during the winter and early spring months, with thirty seconds' exposure, require quite as long, if not a longer exposure at this time (May 6th); whilst, on the contrary, methods unserviceable, or rather requiring longer exposure when the sun's rays formed a more acute angle with the horizontal plane, are now showing much activity. This fact alone points out the extreme caution which, in the present state of our knowledge of the theory of actinic operations, should be observed in anything approaching to dogmatism or sweeping generalisations; there can be little doubt that to these we may trace much of the want of confidence which is so generally felt in receiving novel propositions in this department of inquiry. Many valuable facts have lost their significance from not determining the precise conditions under which they became elicited; and, not unfrequently, from the exalting of a mere incident into the *cause* of their

appearance. This mistake is, of all the operations of photography, most likely to occur in the preparation of dry plates: a great number of substances is necessarily used, and even in the hands of the most careful and experienced operators, accidental phenomena may occur, which, unless jealously checked by experiments, may be magnified into undue importance; or, on the other hand, mere suggestive appearances, which, if diligently worked out, might result in the discovery of invaluable principles, stand the chance of being altogether lost sight of. If this be considered a dolorous view of the case, the writer can only say that it is the result of some thirty years' study in a somewhat allied department of research, organic chemistry; but he is bound at the same time to add, that, notwithstanding all the labour, disappointment, and discouragement that must ever attend upon abstruse researches, the gratification of establishing a fact, and feeling that he can conscientiously recommend it as such to others, is more than a return for his pains. And now—having made these general statements—to prevent their interrupting the course of more specific description, we will just remind the reader that two classes of sensitive surfaces exist, to one or other of which we may refer all the processes which come under the domain of photography.

1. We have a surface so prepared that, having been exposed to the influence of light, the iodide of silver remains in a quiescent state, until stimulated into action by a developer; to this class belong the usual wet collodion and most of the dry processes.

2. In addition to such a surface, we introduce a

substance which not only places the iodide of silver in a condition to be acted upon by a developer, but initiates the action during the exposure of the surface to light. The Talbotype paper and dry tannin processes of Major Russell are instances of this latter class; and the methods proposed in the following chapters will illustrate both of these divisions.

CHAPTER II.

MR. MACNAIR'S PROCESS, WITH GENERAL DESCRIPTION, RESULTS, AND REASONS FOR DEPARTURE FROM DIRECTIONS AS TO TEMPERATURE AND SUBSEQUENT TREATMENT OF PLATES—THEORETICAL CONSIDERATION OF THE PROCESS, AS DEDUCED FROM THE CHEMICAL CONSTITUTION OF THE MATERIALS USED — REASONS WHICH SUGGESTED THE USE OF THIS PROCESS— LABORATORY EXPERIENCE, WITH FORMULÆ FOR PREPARATION, AS DICTATED BY RESEARCH—REMARKS ON VARIOUS POINTS NECESSARY TO BE OBSERVED FOR CARRYING OUT THE WRITER'S PLAN—PROPERTIES OF THE PREPARED PLATE IN RELATION TO STABILITY, SENSITIVENESS, FIRMNESS OF FILM, &c., &c.

THE announcement to the Photographic Society of Scotland, in the Spring of 1860, that a new dry collodion process, matching the ordinary wet process in sensitiveness, had been discovered by Mr. John Macnair, excited the hopes of all who take interest in the practice of photography that, at last, a method was produced which would enable the tourist to dispense with the cumbrous paraphernalia necessary for the ordinary wet process, and give him an opportunity of taking a class of objects which was necessarily excluded from the dry processes hitherto proposed, on account of the slowness of their action; and, amongst others, the writer was induced to adopt it, not merely on account of its promise in a photographical point of view, but because the substance employed, from its known chemical characteristics, seemed to indicate an

opening into mysteries involved in the character of the molecular changes which occur in the course of all photographic operations.

The substance proposed by Mr. Macnair was *malt*, infused in water with a certain amount of precaution as to temperature. A notice of this method was thus introduced by a high authority on these subjects.*

"Another dry process is now attracting great attention in Edinburgh, and is due to Mr. Macnair. It consists in using infusion of malt as a preservative, and great sensitiveness is said to be obtained in this way. A variety of substances has been used as preservatives; for instance, albumen, gelatine, honey, golden syrup, raspberry vinegar, oxymel, gum arabic, serum of milk, pale ale, and, lastly, infusion of malt. There are no doubt slight differences of action amongst these substances; but we do not see at present why infusion of malt should be superior to the other preservatives named."

The writer took a different view of the matter, and for the following reasons. All the substances which play an important part in the production of the photographic image are either aggregate forms, the molecules of which are held together by very slight chemical affinity, or they are the derivatives of such; and it would be difficult to name a substance in which these two properties are more remarkably united than in the case of malt. We are acquainted, for instance, with a variety of substances, differing widely in their appearance as to physical characters, but all comprised between the limits of the formulæ, $C_{12} H_9 O_5$, and

* *Photographic Quarterly Review*, by Mr. Sutton, June, 1860.

$C_{12} H_{14} O_{14}$, differing, in fact, in elementary composition only as to the quantity of the elements of water which they contain; thus, dextrine or British gum, $C_{12} H_{10} O_{10}$, only differs from starch $C_{12} H_9 O_9$, in containing the elements of one equivalent of water; cane sugar $C_{12} H_{11} O_{11}$, in containing the elements of two equivalents of water; crystallised sugar of milk, $C_{12} H_{12} O_{12}$, in containing the elements of three equivalents of water; and so on to the sugar of fruits, $C_{12} H_{14} O_{14}$, which contains the elements of five equivalents of water.

Now malt contains, not only the radix of this series —*starch*—which is capable of being thus transformed, but it contains, in rich abundance, this radix actually transformed into some of the substances above alluded to, but pre-eminently disposed to still further disintegration, from the very circumstance of its containing within itself the catalytic body which, above all others, effects these changes with infinite rapidity, and, for that reason, called *diastase*, with such energy, moreover, that a single part of this substance is capable of converting 2000 parts of starch, first into dextrine, eventually into grape sugar. Certain conditions, indeed, are necessary, and these are generally supposed to be very simple, but are, in fact, mightily effective engines in all organic changes—*heat* and *moisture*. Nor will it escape observation that two of the substances above mentioned, gum and grape sugar, are familiar to us as agents employed from the earliest days of photography, grape sugar especially, as what was supposed to be an accelerator, and, at one time, much recommended in the wax paper process—an accelerator

certainly in one sense, as the writer can testify, for it has a marvellous tendency, in slow development, to produce excessive action in the developer and to cause the silver to be deposited, not only on the points acted upon by light, but over the whole surface, thus destroying the purity of the whites and damaging, if not spoiling, the negative. Again, collodion itself is the derivative of a body, *cotton*, closely analogous in its chemical composition to starch, and coming within the series of compounds to which we have alluded: analogy, then, was not urged beyond its legitimate bounds in suggesting that the powerful catalytic body, *diastase*, might, even in collodion itself, effect a change highly conducive to initiating or accelerating changes in the iodide of silver under the influence of light. Such were the motives which induced the writer to experiment upon the malt process of Mr. Macnair; and, of course, the first step was to take up his formula literally as given by him.

Three years have now elapsed, and, until lately, little has been heard of this subject; but from various causes, it is now attracting some attention, and with the very considerable deviations from the plan as originally proposed, and which the writer is about to describe, he believes it will be generally found much quicker than most others hitherto described in its operation; at the same time giving a clean negative of excellent printing capability. The amount of detail and general harmony of the picture will much depend upon the collodion, nitrate of silver bath, and other considerations which will meet with due attention in the subsequent portion of this pamphlet.

A leading article in No. 189, May 1st, 1863, of THE BRITISH JOURNAL OF PHOTOGRAPHY, contains a reprint of the instructions for the preparation of the malt infusion, communicated to the Photographic Society of Scotland, by Mr. Macnair; and, as this work is in the hands of all photographers, it is not necessary to repeat them. It must, however, be remarked, that in one particular point to which Mr. Macnair attaches importance, a discrepancy exists from that originally given, or, at any rate, from the formula used by the writer and taken from Mr. Sutton's *Photographic Quarterly Review* for June, 1860. The limits there stated are from 155° to 158° F., and it was with an infusion thus made, observing the original directions in every other respect to the letter, that the experiments of the writer were first made. Every precaution was, of course, taken as to bath, condition of collodion, &c., and a plate treated in the moist way as a standard. It would be wearisome to follow up the details as recorded at the time; but the issue of many different samples of infusion was unsatisfactory. The image indeed came out well, and the time of exposure was little more than that of slow collodion. The negative, however, was far too thin and non-resistant of diffused light; and, in fine, the writer abandoned the process as described. Still the theoretical suggestions above stated seemed so inviting that the original plan was modified: in the first place by dispensing with the iron developer, and substituting pyrogallic acid, the advantage was marked; still, the uncertainty of obtaining uniform results as to the preparation of the malt infusion was annoying, and a few hours entirely

changed the character of the preservative; in fact, *lactic acid* fermentation took place, and, contrary to expectation, the action now set up destroyed the hopes of doing anything in this direction.

Passing over many other experiments, of which copious notes were taken, the writer finds the following entry in his journal book, bearing date April 6th, 1861.

Section 133. 1. Recently crushed pale dried malt was mixed with cold water into a thick paste, and water at 212 F. added, with continual stirring, until it was thin; the whole was then placed in a moderately heated oven and left to infuse for some hours; having strained through muslin, the fluid was placed, with its containing vessel, in boiling water, and kept at that temperature until the albumen separated, it was then strained.

2. As a preservative fluid, this was found too concentrated.

3. Diluted with half water, it answered well, but better,

4. When another half bulk of alcohol was added, boiled and strained, &c., &c.

Section 134. The mode I pursued, with the greatest advantage, is as follows:—

1. Sensitise in the usual way.

2. Remove by careful washing the whole of the free nitrate of silver.

3. Pour on and off the preservative solution and wash thoroughly.

4, 5, 6, 7. These must be omitted here, although alluded to hereafter, as the writer wishes to fix the attention of the reader on the words *wash thoroughly*.

In former processes, excellent of their kind, the neglect of this precaution brought them into disfavour; a purposed neglect of course, because the idea prevailed, that the more nitrate of silver present in a dry plate the quicker must be the impression of the object sought, and by far the denser the negative. All this is a mistake. Wash a Fothergill plate as long as the film will safely bear it, and you will secure far better results than when loaded with chemicals; and in the malt process, as it afterwards proved in the tannin process of Major Russell, this innovation led to success.

Regarding the above description, it seems rash to mix the water with the malt at the boiling point, for it is well known that, in the ordinary process of brewing, if the water be added at too high a temperature, the several particles of the malt are not disintegrated; a pasty mass is formed, and the action of the *diastase* is confined to the few superficial particles with which it comes in contact; the quantity operated upon, however, in this case, amounting only to a few ounces, with the additional precaution of constant stirring, obviated this disadvantage, and, having previously soaked the malt in cold water, not only was the temperature suddenly lowered many degrees, but the hot water obtained easy access to the whole mass.

And now, so far as the malt process is concerned, no difficulty can arise to any one at all accustomed to operations of this nature; as these experiments, however, were made two years ago, they have just been repeated, with every precaution, and the writer can now, with confidence, recommend the following formula:—

Take two ounces of malt, crushed in a mill, and break it up still further by passing over it several times an ordinary roller, such as is used for making pastry; pale malt should be preferred, because in high dried malt much of the starch is converted into British gum, and a very viscid infusion is produced, not adapted to the purpose contemplated. Place the malt, thus bruised, in an earthenware jug, or any other suitable vessel, and pour on it, by degrees, two fluid ounces of lukewarm water, with constant stirring, and let the whole be kept in a warm, but not hot, place for a quarter of an hour, a cool kitchen oven answers the purpose well; in the meantime raise eight ounces of distilled, or, at any rate, pure rain, water to the boiling point, and pour it on the malt, soaked as above, constantly stirring; cover the vessel and return it to a warm situation, and thus it may be left for two hours, by which time the fluid will have entirely changed its character and become sweet; it may now be allowed to cool for an hour, and then the whole contents of the vessel should be emptied on a canvas or hair strainer, a common sieve in fact, and, when the fluid has run through, a couple of ounces more distilled water should be quietly poured on the pasty mass, and thus the infusion which it retains will be principally removed by displacement. It is very important to pay attention to the quality of the water, and negligence in this respect has in more than one instance led to the rejection of this process; of course, if chlorides or carbonates be contained in the water, which is almost invariably the case with ordinary hard water, the plates, when treated with the preservative fluid,

will necessarily be rendered insensitive from the formation of chlorides or carbonate of silver, in the original plan; the subsequent preparation, however, of the preservative fluid, by the writer's method, will prevent the possibility of the latter salt being formed. On resting for a short time, the strained fluid will have deposited a thick sediment, from which the clear supernatant fluid should be poured; it is not necessary to filter it, which is a very tedious process, and, with the quantities above proposed, fluid enough may be poured off to coat three dozen stereoscopic plates. Pour the fluid, thus obtained, into a Florence flask, or such vessel, add ten drops of glacial acetic acid, agitate, place the flask in a water bath and raise to the boiling point, retaining it at this temperature until the fluid in the vessel boils well, it may then be allowed to cool. As it cools, we shall again find a fluid and sediment, which, as above, may be separated by decantation; add half an ounce of alcohol and the preservative fluid is prepared, requiring, however, in most cases to be strained, though it is useless to filter it, as, even when passed through a filter, it will retain its milky, emulsive appearance, which is no detriment and cannot be removed, excepting by a circuitous, complicated process, and we all know that it is essential in photographic operations to keep the conditions as simple as possible. The subsequent steps are those common to all prepared plates, that is to say, the film of collodion is sensitised in the nitrate of silver bath, and thoroughly washed with distilled, or, at any rate, pure rain, water; the preservative fluid is then poured upon it repeatedly and in such a manner as to ensure

its action upon every portion of the surface, and then, deviating from the directions of Mr. Macnair, the plate is introduced into a dish of soft water and allowed to soak for five or ten minutes; it is again washed with a fresh supply of water and placed in a suitable position to drain, resting one corner on blotting paper. In the course of half an hour it may be exposed to heat in any suitable manner in order that it might become thoroughly dry; the plate, in fact, should be heated to such a degree as the hand will just bear, and may then be stowed away for use.

If these simple directions be followed, no apprehension need be entertained of obtaining a good picture; if otherwise, the collodion or bath is in fault: the principal points to keep in view are careful washing and thoroughly coating the plate. In the Fothergill process, for instance, disappointment frequently arises to the inexperienced from neglect in this last particular. The picture is fully impressed, but patches of insensitive surface cause it to come out unevenly, in consequence of the whole of the water not having been removed, and the combination of the albumen with the residue of the silver salt being confined to certain portions of the plate. Now it must be remembered that the film, however carefully washed, always retains a portion mechanically enveloped in its substance, and it is clear that the mere floating of a preservative fluid thereon does not effect the object proposed; it must penetrate the film, in order to form a combination with the oxide of silver on which its preservative properties depend. With reference to the particular proximate principle, out of the many contained in malt, which

produces the action referred to, it is an obscure and difficult question; but, from certain chemical considerations, it appears to the writer that the efficiency of this preservative fluid mainly depends upon the presence of a small portion of vegetable albumen or some other proteine compound not coagulable by heat. Whatever it be, however, it is easily destroyed; and, in the first experiments on the subject, much vexatious disappointment arose from this cause. The plates, made at one particular time, would be excellent, keep well, and for days after exposure remain uninjured; another lot, prepared by the same formula and with apparently every precaution, would prove treacherous, and, at last, a very simple cause explained the difficulty. It will be remembered that the infusion of malt is *boiled*, and this has a great tendency to save it from decomposition; still, if the temperature be much above 50°, the fluid cannot be depended upon for more than a day or two; viscous or lactic acid fermentation occurs and it becomes useless; for this reason the alcohol was added, but still it is very desirable to use it as soon after its preparation as possible. A disadvantage, in one respect, arises from the addition of alcohol; the solution, when first poured upon the plate and then poured off, leaves a streaky surface just as happens for the first few seconds after plunging the collodion plate into the silver bath; the solution then must be poured on and off repeatedly, until this appearance ceases, or the result will be development in patches. It is not absolutely necessary to add the alcohol at all if the fluid be used immediately as it is prepared, but the plate is less sensitive.

With reference to keeping qualities; plates thus prepared, if rigidly secluded from light, damp, and foul air, may be used at any time, at least within the limits of six weeks; their having been dried at a high temperature is a great security against deterioration, and to the same cause perhaps we may attribute the remarkable firmness of the film, bearing the succeeding operations after exposure without any risk of breaking away, and never blistering; indeed, as a most useful plate for average out-of-door work, it merits great confidence; the time of exposure, which is much less than for a Fothergill or tannin plate, with more specific directions for development, will be stated in a future chapter, and we now proceed to the description of other processes, connected with the above or arising out of it, by which far greater sensitiveness is ensured. For the sake of distinction in reverting to the several processes, they will be designated by numbers, the above being Process No. 1.

CHAPTER III.

RECOGNITION OF PRINCIPLES LAID DOWN—NATURE OF SECOND CLASS OF SENSITIVE SURFACES—ALLUSION TO MR. TALBOT'S PROCESS, AND ALSO TO MAJOR RUSSELL'S—ANALOGIES OF TANNIC AND GALLIC ACIDS—GENERAL CHARACTERS AND DESCRIPTION OF PROCESS II.—EXPERIMENTS ON THE MIXTURE OF MALT AND TANNIN;* SPOILED PLATES—EXTRACTS FROM NOTES TAKEN AT THE TIME—PROPERTIES AND DESCRIPTION OF PROCESS III.—MOLECULAR STRUCTURE OF GLYCERINE† AS COMPARED WITH OXALIC AND FORMIC ACIDS—EXPERIMENTS—FORMULA FOR PRESERVATIVE FLUID—PLATES PREPARED SUITABLE FOR TAKING INTERIORS—PROCESS IV., ACTION OF FORMIC ACID ON THE FILM.

THE subjects now entered upon assume the recognition of the principles laid down at page 17, and our attention will be mainly directed to the second class of sensitive surfaces there mentioned; those to which, having provided ourselves with a suitable coating of

* At the time of making this research the writer was not aware that such a mixture had even been proposed for the dry-plate process, and has not, as yet, been able to meet with any details of its application. In THE BRITISH JOURNAL OF PHOTOGRAPHY for this month, page 195, it appears that Mr. Fassitt, of Philadelphia, has been experimenting on plates similarly coated, and fuming them with ammonia. The writer has made careful experiments on the plates prepared by his method, and finds that after the thorough washing he urges, no increased capability of development seems to be afforded by exposure to strong ammoniacal gas.

† The writer finds, in the *Photographic News Almanac* for the present year, a formula given by Mr. Fysh for the preserving plates by a mixture of honey and glycerine.

iodide of silver on a glass plate, we make the addition of one or other of the substances which experience teaches us have a tendency to elicit or bring out the image on the plate, which, in fact, sets the molecules of the iodide of silver into motion and induces them to assume a physical condition favourable to the main object which we have in view, the production of a surface which will, in certain places, permit light to be easily transmitted, proceeding through different grades of density, until at last not a ray of light can pass through other portions, even when exposed to the influence of the brightest rays of the midday sun.

The great epoch of photography as a useful art, that is to say, when it was no longer necessary to proceed through a circuitous and expensive mode of treatment for the reproduction of the *facsimile* of each individual subject, but when a happy plan suggested itself of multiplying impressions in a simple and economical manner, to almost any extent from one image so taken, was ushered in by Mr. Talbot, and whatever advances may have subsequently been made by the introduction of methods more suited to increasing requirements, his researches must ever be regarded as those which gave the first impulse leading to the present universal practice of photography, whilst, at the same time, the method proposed by him is, even at present, the only one available for the purpose of the naturalist and other scientific travellers, in situations where the cumbrous apparatus required for the usual collodion process cannot be introduced, and from which results could not be transmitted for multiplication. In the present state of our knowledge, many, if

not most of the phenomena, which exhibit themselves in the processes alluded to, are involved in much mystery; and this must be expected, not only from the impossibility of putting the changes which occur in a condition to be observed, but also from the very minute quantities of matter on which we are called to operate. Much, however, has been done by sound philosophical deduction, and much more challenges the attention of the philosophical inquirer in the way of research.

It is well known that in the Talbotype process a very delicate coating of iodide of silver is first obtained on a surface of paper, and that, when it is desired to impress an image on this surface, previously to exposing it to light, it is moistened with a weak solution of nitrate of silver, gallic acid, and glacial acetic acid; that, under these circumstances, the iodide of silver, which in its former condition remained, so far as appearance is concerned, perfectly unaffected by light, is, after being so treated, almost immediately impressed with the figure of any object presented to it in the camera. In the usual collodion process, and that described in the last chapter, analogous changes are produced, not in the camera, but by subsequent treatment after removal from that instrument.

Major Russell, whose researches on the dry processes of photography are so highly and deservedly esteemed, was, it appears, in the habit, some time ago, of finishing the washing of his plates with a weak solution of gallic acid; and from a consideration of the analogy, in reference to chemical composition, which

exists between gallic acid and tannin or tannic acid, he was induced to substitute the latter.

It would lead us into chemical reasoning, unwelcome to the general photographic reader, if, by the introduction of chemical formulæ, we were to compare these two substances. It will be sufficient to state that we can in a most satisfactory manner trace their analogy, and refer the formation of gallic acid from tannin to the absorption of oxygen gas; and indeed, it is a well-known fact, that an infusion of gall-nuts, after long exposure to atmospheric air, becomes, with other changes, loaded with gallic acid. Our purpose, so far as description is concerned, will, however, be sufficiently met by recognising tannic acid as a highly metamorphic body, and that the result of the molecular changes of its constituent parts is the production of a substance specially used for the eliciting of the latent image impressed by light on the iodide of silver and presenting it to the eye. With this material then, Major Russell coated a collodion plate, having previously carefully washed off the free nitrate of silver; for it must be observed, that a solution of tannic acid, brought into contact with a solution of nitrate of silver, becomes instantly decomposed, and requires the presence of acetic or some other acid to retard its action. The plate, when exposed in the camera, and subsequently treated with developing agents, afforded an image of remarkable beauty, and meeting many of the most important requirements of the photographer: a practical difficulty, however, presented itself in the mechanical nature of the film. The tannin acts upon the collodion in such a manner that it contracts in

drying, and, when again moistened, separates itself from the glass. For the means by which this difficulty was most successfully overcome, and the description of the details of the process, the reader is referred to Major Russell's valuable work on this subject, the utility of which extends to modes of manipulation and hints of great practical value in relation to photographical operations generally; and this brings us to the consideration of another method, which commends itself to the tourist, as one of greater rapidity than that described in the last Chapter.

Process II.—Any person who has employed the malt infusion as a preservative must have remarked its gummy feel. Indeed, this property in the process, as recommended by Mr. Macnair, in which the infusion is dried on the plate, is inconvenient on account of its retaining the dust, which unavoidably floats in the operating room, with great tenacity, occasioning, in the future processes, transparent spots in the high lights. But, on the other hand, this property is of advantage in the plan proposed by the writer—in fact, when first applied it causes the collodion film to adhere with great firmness to the glass, thus rendering it capable of bearing somewhat rough after-treatment with impunity whilst being washed off. When this purpose has been effected, the plate can be dried without risk from dust. Now, it occurred to the writer that this property might be still further utilised, and the process much improved, by the addition of tannin to the malt solution; and, early in the year 1861, an experimental inquiry was instituted on the subject.

1. On adding a solution of tannin to the infusion of malt, as before described, a copious flocculent precipitate was thrown down.

2. The supernatant fluid retained a milky, emulsive appearance, which could not be cleaned by filtration. The principal part, if not the whole, of the organic matter contained in the malt infusion seemed to have been precipitated; and, although the fluid still retained just a trace of sweetness, with the smell of the volatile oil of the malt, still, little hope was entertained that any other results would be obtained from its use as a preservative than from a simple solution of tannin; but, on evaporating a portion of each solution on a separate glass plate, it was observed—

3. That a portion of the malt material still remained, rendering the characters of the dried extract palpably different from that of dried tannin. It was, therefore, determined to proceed, and in the following manner:—

Five grains of tannic acid were dissolved in an ounce of malt infusion, prepared as at page 26, but without the addition of alcohol. After the precipitate had subsided, the fluid portion was decanted and filtered through coarse paper. It was then used as a preservative fluid, with precautions, especially in reference to washing, as in Process I.; and plates thus prepared were exposed as usual, with the following most discouraging result, as extracted from the writer's note-book:—

"*April* 10*th*, 1861, section 137.—The tannin solution spoiled my plates; they developed all over. At any rate, in this process it must be used with far greater caution." And, had the research been closed at this

point, a most valuable resource to the tourist and dry-plate photographer would not have been thus introduced. The note states that the plates developed all over. Of course they did: they were *over*-exposed on a lovely April morning, about 11 a.m., for the same time as used in Process I., and treated, as regards development, in a manner appropriate to that process, which will be described in Chap. IV. Many other trials followed, with various treatment as to time, &c., and, on referring again to the notes, an entry is found:—

"*April 15th*, section 140.—Since writing section 137, a considerable number of experiments have been made with the malt preservative and tannin conjointly. The following plan answers admirably:—

"1. Having prepared malt infusion and strained it, add one-third bulk of alcohol. Leave to deposit, and filter.

"2. Just before using, add an equal bulk of solution of tannin in water, five grains to the ounce, and again filter."

Other substances were now tried, which are only recorded to save others from working in a wrong direction, thus—

"*May 1st*, section 150.—Instead of tannin, sulphate of iron was used with the malt infusion, and the result was excellent;" but

"*May 2nd*, section 151.—Putting together all the results I have obtained, the most sensitive and convenient plan is the malt infusion with tannin." And again: section 153, same date.—"A negative I took this afternoon, at 5.30, fully proved the superiority of the

malt tannin over every other preservative process I have tried."

The writer's note-book continues to register results from time to time, and negatives, still produceable, began to accumulate — failures as well as others — which gave a clue to systematising the plan in such a way as to prepare it for more general adoption; not, however, without many perplexing misadventures. Thus, it would be found that plates, prepared at the interval only of a few days, with every precaution, varied greatly in sensitiveness. That on some days, dull and cloudy, better results were obtained in a shorter time than on days which promised more energetic actinism; and especially that a strange perversity in many cases was observed between the wet and dry process. Thus, on some occasions twice the usual exposure was required in the dry process, whilst no perceptible increase of exposure was needed in the wet process, with many other anomalies, the causes of some of which have been ascertained, and will be explained in Chapter IV., whilst others still remain as objects of inquiry; and the extracts from the note-book, on this part of the subject, will conclude with a satisfactory entry relative to the keeping properties of the plates, which ample, subsequent experience has fully confirmed.

"*Nov. 2nd*, 1861, section 182.—Obtained an excellent negative to-day, from a plate preserved in the middle of September. After exposure for two minutes, sunshine, 12 a.m., it was dipped in a bath of aceto-nitrate of silver for three minutes, and developed with gallic acid as usual; afterwards treated with pyrogallic acid and nitrate of silver."

The process just described was employed for the next spring and summer. As might be expected many disappointments occurred, most of which, relating to the preparation of the plates, may be avoided by adhering to the directions in the next chapter, which will be principally devoted to manipulatory details. Others depended on meteorological conditions, which will require much observation and study before the causes are clearly ascertained. This, indeed, seems at present to be the weak point in the dry processes; the time employed by the wet process in placing the plate in a condition to be acted upon by developers is so short, that many disturbing forces, which seem to operate on the dry plate, have no time to act,—and this seems to be especially the case at certain seasons of the year, and even times of the day, which are by most persons considered the most favourable for photographic operations. The best negatives produced, as proofs of this assertion, were taken in the late autumn and early spring months, or in summer, from six to nine a.m.; and, impressed with the considerations above stated, a variety of experiments were made to discover a process still more nearly approximating the usual collodion plan. Of course, the practical advantages of a more rapid dry method, for taking groups and moving objects, were kept in view; but still, the principal aim was to get rid of presumptive disturbing forces, which seemed to operate upon pictures full of detail and, in other respects, unobjectionable, rendering them incapable of such an amount of development as is found necessary for good printing. Another most important point was

not lost sight of,—the opportunity of diminishing the size of the stop in proportion to the sensibility of the plate.

The result of the numerous and varied experiments on this subject will be summed up in the description of—

Process III.—The film then, has, by the former methods, been brought into a condition much more favourable to the action of light than any of the usual processes, whilst, at the same time, its mechanical properties are such as to allow it to bear subsequent treatment without risk of losing it; and, after many experiments, a substance presented itself, which not only promoted sensitiveness in a remarkable degree, but came distinctly under the category of the theoretical considerations registered at page 20, a substance, in fact, which is not only produced from others by changes easily effected, but is itself so nicely balanced as to the forces which keep its molecules in a state of aggregation, that these can be disturbed and assume new forms by apparently trifling causes.

Glycerine, for instance, is a body held together by slight affinities; oxalic acid is another such body; and by placing these two in contact and applying heat, we produce a third body—formic acid, which has recently again come into prominent notice as a photographic agent. Glycerine, moreover, has the property of reducing metals from their solutions; thus, when boiled with a solution of sulphate of copper, the metal itself is thrown down. On adding glycerine, then, to the preservative fluid of infusion of malt and tannin, a sensitised and washed collodion plate,

when coated with the mixture, again washed and dried, was exposed in the camera. The time of year (Nov. and Dec., 1862) was certainly not that usually chosen for testing the capabilities of dry plates: the results were, however, favourable, as good negatives were produced with two minutes' exposure, not longer than had frequently been given with plates prepared as in the other dry processes in the height of summer; and it now remained to determine the most favourable method of applying the process as thus modified.

In the first place, however, it was necessary to decide which of the two—the malt infusion or the tannin in conjunction with the glycerine—was most effective, or whether all three were necessary: to an ounce, therefore, of the infusion of malt, was added a fluid drachm of glycerine. The result was far less sensitive than of the three conjoined—in fact, did not appear more so than the malt infusion alone. The next coating was with tannin, five grains; water, half-an-ounce; glycerine, thirty minims; the plate seemed quite as sensitive as with the original solution, indeed, with other precautions as to the preliminary preparation of the plate, negatives were produced between Dec., 1862, and this month, May, 1863, some of them with hard frost and cold winds, in from thirty to fifty seconds, and many of the best in cloudy weather. Other avocations, and preparing these notes for press, in hopes that they may be advantageous to tourists in the approaching season, have prevented the exposure of many plates for the last week or two; and those which have been exposed, from some cause which has

not as yet been investigated, are not so sensitive as those used in the winter and early spring, and fifty seconds with the same glasses and diaphragms have not been found too long for exposure: most probably, however, either the bath or preservative fluid will be found deteriorated.

We have now, therefore, arrived at a stage of our investigation which shows that the previous processes may be much simplified, inasmuch as the malt infusion may be dispensed with altogether; though, in certain cases which will shortly be pointed out, it may still be used with advantage, and we now proceed to give the formulæ which were decided upon, merely remarking that the quantity of tannic acid employed is much larger than in the former process, as will appear in the sequel.

The following quotation is from the notes entered at the time:—

"*Dec. 4th*, 1862, section 211.—The preservative solution for the tanno-glycerine process is thus prepared:—

Solution A.	Tannic acid.....	30 grains.
	Water	1 ounce.
	Glacial acetic acid	5 drops.
Solution B.	Glycerine	1 drachm.
	Solution A.	2 drachms.
	Water	5 „

which latter is poured on and off the plate in the usual manner adopted at this stage." The addition of acetic acid was made in consequence of slight fogginess observed on certain portions of the plate during development, and it certainly remedied the evil; but the bath was in fault, as it gave foggy results with

the wet process. A few drops, however, of acetic acid brought it back to working order, and here it may be remarked that in these processes the addition of a certain quantity of acetic acid, determined by experiment, not only does not produce insensitiveness, but actually forwards the progress of development, and for this reason:—the slightest deposit of silver, not elicited by the action of light, but by a general decomposition of the developing fluid, will, as the development proceeds, injure if not totally destroy the plate, and immediately as such deposit, either above or under the film, takes place, it is useless to proceed with the future manipulation. Major Russell has mentioned this with reference to the tannin process, but want of time prevents the writer referring to his work for the quotation.

What may be expected in taking interiors upon a plate treated with this preservative will be best seen from an extract.

"*Dec. 5th*, 1862, section 213.—Exposed a stereo.-plate in the drawing-room at noon, the day exceedingly cloudy and dull—easterly wind: one side exposed for ten, the other twenty minutes. Dallmeyer's stereoscopic double-arrangement, diaphragm No. 4; both came out after long development—nine hours."

The development was by a favourite slow process, which will be given in its proper place, and produces extremely sharp negatives, as it contains but a very small quantity of nitrate of silver, which is deposited with amazing regularity. That a prepared plate can endure so much soaking without injury is a great recommendation; it must, however, be mentioned that

the collodion used was admirably adapted to the purpose: by the addition of the infusion of malt the film is rendered still safer, but of this more hereafter.

The slow developer was used merely as an experiment; others, far more rapid in action should, of course, be employed under similar circumstances. And now, to bring the descriptive portion of these processes to a conclusion, another will be mentioned which promises very rapid results, and is now under experiment. It, however, requires great precaution, as the details of its preparation will evidently suggest.

Process IV.—The tannin and glycerine are used as before, with the addition of ten minims of formic acid to each ounce of the preservative solution, and when well mixed, which, of course, must be at the time of using, ten minims of solution of nitrate of silver, strength twenty grains to the ounce; the quantity of the two last fluids may be increased to thirty minims of each; but most extraordinary care must be taken thoroughly to wash the plates. Let it also be observed that formic acid of the strength used by the writer, which is the strongest and purest he can obtain, has a great tendency to loosen the film bodily from the plate; in certain kinds of collodion, this has no doubt been observed with *glacial acetic acid,* and the writer has, in ancient times, made use of this device for the purpose of transferring the collodion film; and, indeed, for mounting microscopic specimens this plan is valuable. Take, for instance, the very beautiful ciliary processes of the *balanus porcatus*—the common rock barnacle of our coasts—and arrange them on a small plate of glass; with careful washing all the salt water and its solu-

tions may be removed; the whole should be placed in a slow oven or under the receiver of the air pump to dry, and then a few drops of moderately thin uniodised and freshly-prepared collodion poured over the specimen. This, when dry, may be floated off the plate into a vessel of clean water, with four or five drops of glacial acetic acid, and when sufficiently washed and dried, be appropriately trimmed and mounted for the microscope. The calcareous frame-work of the organs is not injured, as it is inclosed in a coating of collodion, and the contact of the acetic acid with this is so short that no action can take place other than that pointed out. Hundreds of other objects adapted to similar treatment will occur to the microscopist.

The plates, then, prepared by this process have been used by the writer with no longer interval than a day between their preparation and exposure; indeed the suggestion only occurred to him a few days ago; they will, however, thus used, give excellent results and need not be developed for a similar interval after exposure.

It now remains to explain the manipulatory precautions necessary for the successful working out of these several methods, and a comparison ot the special properties and advantages of each in reference to the circumstances under which they may be respectively employed.

CHAPTER IV.

INTRODUCTION TO MANIPULATORY DETAILS—HINTS TO TOURISTS IN THE POSITION OF THE WRITER AS AN AMATEUR—SELECTION OF GLASS FOR PLATES—CLEANING—COATING WITH COLLODION—KIND OF COLLODION ADAPTED TO THESE PROCESSES, WITH FORMULA FOR PREPARATION—ACTION OF AIR AND LIGHT ON OXYDISED COTTON—NITRATE OF SILVER BATH—DETERIORATION FROM USE—CORRECTION—WASHING PLATE FROM SURFACE-NITRATE OF SILVER—APPLICATION OF PRESERVATIVE FLUID—DRYING PLATES—SUGGESTIONS ON SUITABLE CAMERAS—SIMPLE METHOD OF FINDING STEREOSCOPIC ANGLE—TIME OF EXPOSURE—DEVELOPMENT—SLOW DEVELOPMENT, WITH ITS SPECIAL ADVANTAGES—MORE RAPID METHODS—ALLUSION TO FUMING WITH AMMONIA—FORMIC ACID—TREATMENT OF FILM UNDER PECULIAR CIRCUMSTANCES—INCIDENTAL REMARKS.

In entering upon the mainpulatory details of the processes described in the previous chapters, it is hardly necessary to observe that some previous knowledge of photography is assumed: that the reader is practically acquainted with the usual wet collodion process, not merely as a convenient method for taking portraits, for this, perhaps, is the least important use to which photography can be applied,—certainly so in the conviction of those who are able to appreciate the importance of its application to a vast variety of other purposes; to the arts and sciences; to the faithful record of passing events, in a manner so absolutely representative of the scenes of life actually occurring at specific periods, as to leave no room for the poetry

of tradition or the bias of the historian; to the requirements of the naturalist, as affording a *facsimile* of deviations from normal and familiar structure, in cases when representations, to be made truthfully, must be made on the spot, with a rapidity and correctness of detail which would foil the powers of the most facile draughtsman, and that not merely in plane surface, but, by means of the stereoscope, in model relief; to the art student, as saving him cost and trouble, filling his port-folio with correct representations of types of form, in a time far shorter than could be done by ordinary manual labour; to the tourist for health or recreation, as furnishing him with reminiscences of nature's beauties, not only as a future solace to himself, but, with proper description, interesting and instructing those to whom circumstances have denied the enjoyment of travel. It is further assumed, that some experience has been acquired in one or other of the various dry processes already in use; and, should this not be the case, the reader is earnestly recommended faithfully to work out Major Russell's tannin process, following his written instructions implicitly; for, having done so, no difficulty whatever will be felt in practising the methods described in this pamphlet: he will, in fact, walk over the course; and as the readers principally kept in view are those who—purposing to employ photography in a manner subsidiary to its higher purposes, as above hinted at—have neither leisure nor opportunity to practise it except on occasions, a few general hints from one placed in the same position with themselves may not be considered unworthy of regard.

The first of these is to enter upon photographic operations in a systematic manner and with a definite plan. No one would think of arriving at any excellence in sketching by at once attempting to take a landscape, without the slightest knowledge of perspective or the capability of drawing a perpendicular line; and yet this is an absurdity more frequently than not practised in photography, and is, no doubt, the main cause of much of the disappointment which many have experienced. There are certainly difficulties in the art, especially in its more pretentious departments, which would baffle any but those who make it a daily practice,—nor do these always escape; but there is no reason why any sensible person, with an ordinary camera, cheap glass, and the appropriate chemicals, should not at any time, with certainty, be able to take a view from nature. Commencing with card portraits is, of all other plans, beginning at the wrong end for the tourist. Consider the very different conditions of the two cases. The *carte-de-visite* artist is engaged in taking, day by day, objects of a precisely similar character, many of them identical and fixed objects; the focus may be considered as constant, at least the variations are extremely slight, and the subsequent operations are carried on in an unvarying, mechanical routine. The writer, in fact, cannot view the portrait-gallery in any other light than as a miniature manufactory. The tourist, on the contrary, is in a totally different position: with him every new object presents a fresh problem; arrangements must be altered at every move in every part of the apparatus he carries with him; in addition to this, his mind must be as

alert as his body; and woe to his prospects if forgetfulness or diverted attention cause him for a moment to overlook the many little essential points and precautions which ensure success: in fact, the tourist-photographer must of necessity be a sharp man.

In the next place, let the importance be urged of keeping to one plan, until its practice has become easy and familiar; should it be desirable to resort to others, this at least will be employed with confidence, and it is astonishing, in practice, how this confidence transfers itself, as it were, to any new method; the very conviction that one view at least is safe, so far as circumstances admit, enables the operator to employ any less tried method without anxiety.

And, lastly, plates that fail from any unknown cause should be kept; for, in this art as well as in the art of living, generally failures, if properly used, are exceedingly valuable records, and teach much more to the conscientious student than uniform success.

To begin, then, with the materials required; and first as to the glass plates. Here it is presumed that, for ordinary tourist purposes, the kind known as best flatted-crown will be selected: they are much lighter than those of patent plate; they seem to be harder, and not, therefore, running so much risk of being scratched—they are also considerably less expensive; but, as a set off, they are not so flat as necessary for some purposes; the writer believes, however, that on an average, nine out of each dozen may be selected quite flat enough for ordinary use, and some even for printing on glass by superposition. Of course, in paper printing a little curvature is of no consequence, as by

placing three or four folds of black cotton velvet over the paper, the pressure in the printing-frame will be so evenly distributed as to occasion no great risk: this curvature may even be utilised by coating the concave side, and thus in some degree correcting spherical aberration. Of course, such plates could not be sent out to print, as they could not be treated with such tender consideration as is compatible with their safety. Where great precision and durability are essential, the patent plates must be used, but their weight is so much greater, alluding, of course, to the thick plates, that the tourist will probably confine their use to objects of special interest.

Having decided upon the plates, the next important object is to clean them thoroughly,—for as sent out from the manufacturer, or even neatly packed from the photographic warehouse, they are not in a condition to use; for the mere handling is sufficient to spoil results! The secretion from the pores of the skin of the most cleanly hand, when in contact with a salt of silver and exposed to light, rapidly reduces the silver, as most have experienced in impressions on albumenised paper; and, perhaps, one of these days the salts contained in the fluid of perspiration may be used with success for the salting of paper,—the plates then must be thoroughly cleaned, and an excellent plan is recommended by Major Russell, who substitutes a solution of iodine, in iodide of potassium, for nitric acid. The plates are to be roughed on the edges by means of a file; and it will be at once seen how easy it is, under such circumstances, for a minute portion of nitric acid to remain in the cavities, which, however insignificant

on one plate, produce a most material effect on the bath after three or four dozen plates have been sensitised: for it is well known to practical men, that keeping the silver bath in a delicate state of balance between fogging and insensitiveness, is one of the most important problems in the art, no less applicable to dry than to wet plates. A simple and cleanly plan is adopted by the writer:—A potatoe, having been well washed, is cut in half, and the peel pared off, with a clean knife, for a quarter of an inch round the cut edge; the original cut surface is then slightly scooped out, so as to retain any powder made into a paste with a fluid. Now, in many cases, mechanical means are required to remove impurities, and fine tripoli is generally used for this purpose, subject to the disadvantage, however, that with every precaution, a portion, less finely levigated, may intrude and scratch our plate. Now we are acquainted with many minute crystals, but slightly soluble in water, which are too soft to scratch glass, and yet sufficiently hard for cleansing purposes; and, from several others, the writer has selected the bi-tartrate of potash (common cream of tartar), for this purpose. Having filled up the hollow in the potatoe section with this salt, a few drops of the iodine solution are poured on the plate, and rubbed over the whole surface. It is obvious that this can be done without any risk of staining the fingers, an object of no small importance to lady photographers; an apple, of course, answers the same purpose, and the malic acid assists the operation: oranges and lemons are too yielding for the amount of friction desirable. The plate is now to be well washed in several waters, drained in a colander,

wiped with a clean cloth, free from soap, and, at last, rubbed with a wash leather kept for the purpose, which has been well washed in soda. No pains should be spared in cleaning the plate, when it should be placed in the grooved box until required.

The next process is coating with collodion, of which the appropriate kind will presently be described; and even here some precaution is necessary. Many who have not practised this department of photography imagine, that, on account of its comparative slowness, much greater liberties may be used with the plate than in the usual wet process, whilst directly the contrary is the fact. Certain disturbing forces, which, from the shortness of their duration, hardly operate on the one, produce a fatal influence on the other,—thus, in supporting the plate for the purpose of coating it by means of an ordinary pneumatic holder, in the wet process the plate may generally be removed from the holder, plunged in the bath without further precaution, exposed, and developed, the whole of the operations being completed in a few minutes; but, in the slower process with dry plates, if the back of the plate be not carefully wiped after coating with collodion, the ring of the holder is almost certain to be impressed in the future negative. It must be remembered that, during the evaporation of the ether from the coated surface, intense cold is produced on every part of the back of the plate not shielded by the holder; dew, in fact, is condensed upon it,—and if the holder be not rapidly removed, and the temperature equalised by wiping the plate, the negative will in all probability be lost. The same result must be endangered still more by the

practice of supporting the plate on the tips of the fingers of the left hand, on account of their warmth—indeed, the accident alluded to sometimes befalls the operator, even in the wet process.

As to the collodion adapted to the processes described in this pamphlet, the writer has carefully worked with preparations from almost all the renowned makers, and finds that they may all be used with success, specially excepting those which are devoted exclusively to iron developers, apparently from their containing a large quantity of bromides; and this is contrary to the results of bromides in excess, as applied to Major Russell's process, and described by him in a recent number of THE BRITISH JOURNAL OF PHOTOGRAPHY. These salts do indeed give a rapid image, full of detail; but by no device which the writer has tried can he bring the negatives up to the amount of actinic resistance requisite for printing. Some collodions are made especially for the dry processes, and called powdery collodions, but the more homogeneous films are as safe, and indeed better, for a certain class of negatives, those which are intended for enlarging in the camera. By using the precautions to be hereafter mentioned, no danger need be entertained of the film leaving the glass, with ordinary care, whilst it bears less iodide, more ether, and lies very close on the plate, giving clean negatives, with distant objects beautifully defined. Of course all collodions which are crapy, and make the plate appear as if scratched with the hatchings of a graver's tool, are unfit for the purpose and must be rejected. Few amateurs would wish to prepare their own collodion, but it is a rule with those who under-

take researches to make everything possible themselves, and the following formula may be depended upon:—Good cotton, long fibred and clean, is plunged into a mixture of three parts, by measure, of sulphuric acid, which must be of full strength, and one part of strong nitric acid, which will generally be found not to exceed the sp. gr. of 1·38 to 1·40, having previously stirred these with a glass rod; no artificial heat must be applied nor must more cotton be dipped than the fluid can well cover. After gently pressing the cotton down repeatedly, so that the mixed acids may permeate every fibre of cotton, the vessel is to be covered with a glass plate and left for fully a quarter of an hour; after again stirring with the glass rod, the fluid should be poured off and pressed out; having previously mixed a fresh quantity of acids, in equal proportions of sulphuric and nitric acids, the cotton is to be re-introduced, moved about gently for a minute, and, after covering the vessel as before, left to digest for ten minutes; the acids are then poured off and pressed out, the cotton thrown into a large vessel of water and moved about, frequently changing the water, until they are so far removed that the remainder of the water can be pressed out in a cloth. The cotton is then soaked in a solution of acetate of soda, ten grains to the ounce, thoroughly washed in many changes of water, pressed, dried, and carefully pulled out. Four grains of this cotton are sufficient for an ounce of the usual mixture of alcohol and ether, and, iodised with three grains of iodide of sodium and one grain of bromide of cadmium, this is a very simple form, keeps well, and improves by keeping within ordinary limits. Those who wish to make their

own collodion, without the annoyance of preparing the cotton, may obtain it of excellent quality from respectable houses; but it should be remembered that oxidised cotton soon deteriorates and becomes acid if exposed to air and light, in fact, oxalic and nitrous acids are formed, the slightest trace of either of which will render the collodion unfit for use, and, if the cotton has been kept for some time, it should always be re-washed in solution of acetate of soda, with the other precautions stated, before using it for collodion. The writer has become acquainted with cases in which great disappointment and pecuniary loss have resulted from this cause.

We now suppose the plate to be coated, and ready to dip into the bath of nitrate of silver, which is thus composed for ten ounces:—

A.	Re-crystallised nitrate of silver	320 grains.
	Distilled water	5 ounces.
B.	Caustic potash (avoid ammonia)	2 grains.
	Distilled water	1 ounce.

Mix these, and, when agitated, allow the precipitate to subside, and filter; fill up to nine ounces and add acetate of soda, previously dissolved in an ounce of water, three grains with five minims of glacial acetic acid. The bath is now ready for use, and should be tested for action with a wet collodion plate, developing with pyrogallic acid. If foggy, more acetic acid should be added, drop by drop, until the bath works clear; but the writer has always found the above proportions give good results. It will be observed that the bath is not, as usual, saturated with iodide of silver: the first plate may suffer a little if the weather

be very warm, but it is simpler and safer, for reasons which will presently be stated, to leave it thus.

After a certain number of plates has been prepared, say three dozen, more or less, change will have taken place in the action of the bath: it will not act so readily, and, if the collodion contain an undue proportion of bromides, the character of the negatives will be altered; they will still indeed be full of detail, but will not readily, if at all, admit of such an accumulation of silver in development as is necessary to produce a good negative; the colour of the negative will not be the same as before, and will be much more permeable to the actinic rays. The bath then must be corrected, or a new one formed. The writer would recommend keeping two baths, so that one can be used whilst the other is repairing, which is easily accomplished as follows:—

Pour the bath into a Florence flask, or such like vessel, and boil it in a water bath, or, in less technical terms, in a saucepanful of water. By this means, the volatile matters, alcohol, ether, and principal excess of acetic acid are removed; add the solution of caustic potash, as before, until a brown precipitate of oxide of silver is formed, agitate well, expose to the sun for an hour or two, filter, add fifty grains of nitrate of silver and a few drops of acetic acid, when the bath will be ready for use immediately as the nitrate of silver is dissolved. A larger quantity of acetate of soda may be added at first, but it is not advisable, as the acetate of silver is sure to accumulate, and, after the bath has been thus corrected four times, from this and other causes, it will be better to discontinue its use; no waste

whatever need be made, as it is only necessary to throw down the chloride of silver with a solution of common salt; the curdy precipitate is repeatedly washed with common water, collected on a thick calico strainer, the fluid squeezed out, and the whole dried in an oven, when the chloride of silver may be collected and sent to a respectable assayer, who will give the full value of it, or send back re-crystallised nitrate of silver in exchange. Those who are unaccustomed to chemical operations will find this a far more economical plan than re-forming the nitrate of silver, which, on the small scale, can only be done with considerable loss of material.

Having then sensitised the plate, by allowing it to remain five minutes at least in the bath, it is transferred into another containing distilled water, or, at any rate, soft water which has been boiled (if the latter, with the addition of five drops of glacial acetic acid to each ten ounces), and left to soak for some minutes, until the oily appearance of the film—familiar to everyone—ceases, and then placed in another dish of water for a few minutes longer: the water in the bath may be used for some dozens of plates, to collect the excess of nitrate of silver from the sensitising bath, then reducing it to chloride as above stated; the water in the dish should be frequently replaced: a gentle stream of water is now poured from a jug, and the plate is ready for the preservative solution selected from those described in the preceding Chapter. In the tannin and some other processes, a small quantity of chloride is recommended to be added to the water in the dish; the writer does not advise this, as the pre-

sence of chlorides is a fruitful source of what are known as pinholes in the denser portions of the negative.

The preservative fluid then is poured into a clean developing glass, in the proportion of one ounce for every six plates, after which it should be replaced with fresh fluid, as it becomes much diluted by use, and the plate, if of stereoscopic size, being held at the upper corners between the thumb and fore-finger of the left hand, is to be covered with the fluid, beginning near the top and chasing the surface water downwards, allowing it to run into the developing glass, and repeating this action several times; now reverse the plate, and proceed in the same manner. It is essential, as before stated, that the preservative solution should not merely float on the film, it must penetrate it to be effective; and the successful preparation of the plate depends mainly upon the care with which this part of the process is accomplished. The plate is now placed in a dish of clean water, which will answer for two or three dozen plates, and allowed to soak while others are preparing. With a little system these operations may be carried on in succession with considerable rapidity, and a dozen plates can easily be prepared in an hour. Nothing now remains but to pour a gentle stream of water over the plate and place it, resting on one corner, on blotting paper to drain, the upper corner of the plate being supported against any suitable fixture. When the whole of the plates proposed to be prepared have thus drained they may be placed inside a box, reclining against the sides, with the sensitive surfaces upwards, and removed to a moderately-heated oven until they are as hot as the hand can bear, and then,

being finished, they should be stored away in the grooved box for use.

It is hardly necessary to say that all these operations should be carried on in a room to which not a ray of actinic light has access. The plates are so sensitive to diffused light, that, when used for printing transparencies, a fraction of a second's exposure to a northern sky is abundant. They may also be printed by gas-light, or, if it were not for the objectionable fumes, by the light of inflamed phosphorus, which the writer finds highly actinic. It seems equally unnecessary to point out the prudence of testing the bath, each time corrected, by means of a wet collodion plate, or, in making a stock of plates from fresh quantities of preservative fluid, to try one dry plate before proceeding further: these precautions may give a little more trouble, but this is amply compensated for by the comparative certainty with which a tour will be entered upon, and, indeed, the word *trouble* is unknown in research.

We are now prepared to take a view, and assume that the reader is fully acquainted with the ordinary mode of doing so, and has had some previous practice in the operation. The apparatus for the purpose is, of course, the lightest that can be procured, compatible with steadiness and the absolute exclusion of a ray of light which does not enter through the lens. The admirable specimens of work in this department afford the tourist a wide scope for choice. It is probable, however, that, if going a distance, he will select a stereoscopic camera,—for, although the views may be small, it is no great feat to enlarge a picture of three

inches square to one of 12 × 10 inches or much larger by the solar apparatus.

The writer has hitherto avoided all names in connection with collodion or other business departments of photography, feeling such matters to be totally without the scope of this pamphlet; he may, however, be permitted to state, that he has found a small stereoscopic camera, purchased from Messrs. Squire, very portable and useful as a travelling companion, with a few modifications, which may be adopted with great advantage to ensure greater steadiness, a most material point for the tourist who cannot always screen himself from the wind. The two pieces of wood, which are attached to the base of the camera alluded to for determining the stereoscopic angle, are removed, and the camera screwed on to a slip of well-seasoned mahogany, 4 × 1 inch, and half-an-inch thick, bevelled off on both sides of one surface—the narrower surface towards the camera. Another piece of wood, which may be deal, twelve inches long, three inches wide, and an inch thick, is now provided with two thin pieces of mahogany of the same thickness as the former, each bevelled off on one side and screwed or otherwise fastened on to the deal, with the bevelled edges downwards, and in such a manner that they may serve as accurate guides within which the portion attached to the camera may slide, after the fashion of a Wollaston's sliding scale; the other side, having a brass plate, with a screw hole tapped in, fastened on, will furnish the means of its being attached to the tripod stand. Suppose now the whole apparatus set up for work; the camera is brought to the right side

of the table, and a view taken. It is then pushed towards the left side three inches, which may be marked for permanent use; the table, with all its belongings, should now be very slightly rotated on the stand for one quarter of an inch, measured from the extremity of the table, and an excellent stereoscopic effect will be produced for a lens with a focus of 3·75 inches. The amount of this rotation is not of much consequence, provided it be not in excess, which would produce exaggerated relief; if not rotated at all, the object would still appear stereoscopic, though with under relief; besides, in a double picture, taken with the monocular camera, it is not necessary to cut the paper, provided a given point in each picture does not exceed $2\frac{1}{2}$ or $2\frac{3}{4}$ inches in distance from its companion, and this is ensured by the formula given. Again, this contrivance is applicable to pictures of all sizes, proposed to be taken stereoscopically: thus, for the sake of round numbers, take four inches as the focus adapted to the above distance, place on the slide a camera of a larger size, fitted with a twelve-inch focus lens, capable of taking a whole-plate picture; now 4 : 3 :: 12 : 9 inches the distance through which the camera will have to move for stereoscopic effect in taking two pictures, the degree of rotation being the same as before. This very simple subject of the stereoscopic angle, as theoretically viewed, has been much misunderstood, and many absurd instructions given as to the distances required; but the reader will not be disappointed in putting the above hints into practice. Two excellent double slides were sent with the camera, but they were found too delicately con-

structed for brass hinges, the screws not having sufficient depth of substance to hold, and soft kid leather was substituted, a strip being fastened over the whole length which connects the two sides of the slide. The writer employs a still more simple camera for twin lenses, which can be constructed in a short time by any one, even on a journey, if necessary. The material of which it is principally composed is thick pasteboard, covered on the outside with black holland, lined on the inside with black cotton velvet; the lenses, single view lenses of 4½ inches focus, are placed three inches apart, measuring from centres, the flanges being screwed on to a mahogany slide, so arranged that it can be moved in a vertical direction for a full inch, thus giving an opportunity of varying the position of the horizontal line for different objects or at different elevations; the frame in front is adapted to the slides above mentioned. Both back and front can be removed at pleasure, the pasteboard folded up, and the most jealous *douanier*, meeting with the whole in a traveller's portmanteau, would scarcely recognise the individual parts of a most useful and efficient binocular camera. The weight of stand, camera, slides, and all the accompaniments necessary for a journey, is under seven lbs.; indeed, it would not be easy to construct a more convenient travelling companion; as the slides fit both instruments,—the former one being arranged as a monocular for double glasses,—the addition of weight in travelling with both is not worthy of consideration. The writer does not burden himself with a level, but, as a substitute, on the portions of the ground glass occupied by each picture, a line in pencil is drawn to-

represent the horizon, and a vertical line to secure perpendicularity. Two legs of the tripod being fixed, it is easy, with the other, to obtain such a position that the two pictures may assume precisely the same relative position and be truly level. Nothing further remains than to elevate or depress the front slide, to determine the horizontal line desirable; a comparatively unpractised eye will detect any deviation in level; but, at the same time, when great precision is required, such as for future measurement by scale, additional precautions will be necessary. These details arranged, it only remains to remove the focussing slide, substitute one containing a prepared plate, and expose. The time for exposure, with an ordinary stereoscopic lens and stop one quarter inch in diameter, will vary, in Process I., from one minute and a-half to two minutes, according to the nature of the object and the state of the atmosphere; in Process II., about one minute; in Process III., thirty to forty seconds; in Process IV., the time necessary has not yet been determined, but about half that time will probably be found sufficient. There are, of course, minimum periods to which the operator would not confine himself, excepting where objects liable to move are to be represented.

It must be borne in mind that the utmost precaution is necessary in excluding the slightest admission of light. Previously to undertaking each tour the camera and slides ought to be thoroughly overhauled; and, before taking a view, the whole camera, excepting lens space, and slides should be covered with a black cloth, the slides being opened under the cloth. The

whole apparatus also, especially in windy weather, should have the benefit of the shelter of an umbrella, which will greatly assist in securing steadiness.

We now proceed to the important subject of development. By any process mentioned a picture can scarcely fail of being impressed on the plate, and its resulting in a good negative depends entirely on the operator. Having then returned to the dark-room, or its equivalent, the first step, with reference to the plate, is to pour distilled, or, at any rate, water absolutely free from chlorides or carbonates, over it, until the film is thoroughly moistened. In travelling, it is not always possible to obtain distilled water, but easy to find a substitute by dropping a weak solution of nitrate of silver into it until the fluid no longer becomes turbid. Snow water has been recommended, but we must be on our guard as carbonate of ammonia may be present. The water of many mountain lakes is also pure, but much will depend on the geological structure of the surrounding country: we should, for instance, expect to find the water more free from metallic solutions at Geneva than at Llanberis; in the processes, however, described in this pamphlet, more than ordinary precaution is necessary, and it will be prudent, when distilled water cannot be obtained, to resort to the device mentioned. The next step is to place the plate on the levelling stand, pour a little water over it, so as to cover the surface, whilst we prepare a small quantity of a saturated solution of gallic acid in water, which is easily done by keeping in stock two or three ounces of a saturated solution of that substance in alcohol, and adding one drachm of this to an ounce of water;

or a saturated solution may be made in boiling water and suffered to cool. Pour off the water from the plate and replace it with this solution, pouring off once or twice, and leaving it to soak into the film for five minutes; in the meantime drop into the developing-glass five drops of *glacial acetic* acid, with the same quantity of solution of nitrate of silver, twenty grains to the ounce of distilled water; add to this the fluid from the glass, or, better, a fresh portion of the same, and when it is evenly distributed over the plate, leave absolutely quiet until the whole of the details of the picture are well out. In this, which is alluded to as the slow developing process, we find some special advantages: in the first place, from the comparative weakness of the developer, the action, instead of rushing forward, proceeds with great regularity, and, from the small quantity of nitrate of silver added, the particles of silver are successively deposited on the different lights with an evenness and precision approaching the electrotype process; we have, thus, again the advantage of being able to watch progress and leisurely decide upon the period at which we may venture upon pushing the development, if considered necessary; still further, we may frequently by this process obtain beautifully printing negatives, which would at once be rejected, if the plates had been treated with quicker developers in the first instance, as not being sufficiently exposed; the high lights would appear at once, but no amount of silver or strength of developer would produce an harmonious negative; in this slow process, however, the image is coaxed out, and even under unfavourable circum-

stances as to position and light, the results are very satisfactory. The impetuous operator will of course reject it at once, but to one whose object is to obtain negatives from which he can print with care, and refer to with confidence, the mere suddenness of the appearance of the image will not compensate for delicacy of detail and resistance to light. It is a great mistake to imagine that more work can be done with a tent and the wet process than by the dry, even with such a slow developer as the above, for any number of negatives may be undergoing development at the same time; and, taking the general results of a tour, the dry process operator will store in his grooved boxes a far greater number of finished plates than one following the usual out-of-door methods, and at the same time enjoy his trip in every other respect, having no anxiety about condition of chemicals and numerous other perplexities that, more frequently than not, harrass the other and send him home in a very disappointed and dyspeptic state.

But to proceed. We must now consider our developing plate under two conditions. After a reasonable time, say half an hour, we find it well developed, with every detail out, and the gradations of light and shade satisfactorily established. In many cases this stage of our operations may be considered as complete; but the writer, almost invariably, pours off the gallic acid, washes gently, and then uses a fresh developer of pyrogallic acid with citric acid and a drop or two—the less that will answer the purpose the better—of the ordinary twenty-grain solution of nitrate of silver. This is done, not so much to increase the blackness

of the negative as to modify its *tone*, which it does materially, rendering it more capable of resisting the actinic rays. Once or twice pouring off is sufficient for the purpose, and, if continued too long, an appearance takes place which is differently accounted for. The writer alludes to that of small breaches in the film, generally called pin-holes. Some attribute these to dust, others to the presence of chlorides in the film; but, when we consider the circumstances under which these holes occur, and the fact that we can produce them when we like, the reason of their appearance and the means of avoiding them will easily suggest themselves. The film of collodion, after it has undergone the previous treatment, is comparatively rigid, and admits of but little extension. Now, with every increase of shade during development, we introduce a foreign body into its substance, and a time arrives at which the film, unable to receive more, breaks up, exhibiting minute spaces, just where we should expect, at the points of greatest deposit. One of the chief commendations of the slow process of development is, that this deposit proceeds so gradually and evenly that the film has time to accommodate itself to the new circumstances under which it is placed. By the application, however, of a powerful developer and more silver, the film is rent asunder and the negative injured. Whether this explanation be satisfactory to others or not the writer has found it of great value as a practical guide, especially under the second condition of the plate under development to which he has alluded.

If the plate has been exposed under untoward cir-

cumstances, perhaps after the slow developer has been floating upon it for half an hour, but very little action is apparent, and the solution, if poured off, is still perfectly clear; a little change of colour is of no consequence. Return the solution and leave it on for an hour longer, if necessary, until the details are well out; any attempt to push the development in this state is useless, and if the negative must be lost, far better that it should happen from a loosened film—a very unlikely occurrence with ordinary care—than from unequal development; we say better, because even when a film does become loosened, a negative obtained with cost and labour will generally have some portions left worth preserving. The detail then having come out, pour off the developing solution and wash very carefully, still on the levelling-stand. Prepare now the pyrogallic acid developer, as above, and in both cases, *avoid the use of alcohol*, adding ten drops of silver solution to the ounce of developer; pour this on and off the plate several times, until the negative is dark enough in the skies, and again wash with distilled water. The foreground will now, in all probability, be not sufficiently developed, and may be treated thus:—Prepare a fresh quantity of developer, draw it up into a dropping tube with a large bulb, and direct it so as to flow over the less-developed portions of the plate, held in a slanting position; the fluid is allowed to run into the developing glass, and the operation repeated. A very little experience will render the manipulation easy, and this little artifice will, under some circumstances, be found a most useful resource.

The writer has found this slow development to meet

his requirements so successfully that he generally uses it in preference to others, especially in the dry processes which he adopts; quicker methods may, however, be frequently used: thus, when a plate has been fully exposed—and it may here be mentioned that a reasonable over-exposure does not seem to injure the three first of these processes, such, for instance, as the difference between forty seconds and one and a-half minutes, in Process III.—We may proceed as follows:—

Pour distilled water over the plate until the film is equally moistened, and, having prepared a solution of pyrogallic acid, three grains to the ounce of distilled water, pour it over the plate, resting on the levelling stand, and allow it to remain four or five minutes; then into a developing-glass drop five drops of glacial acetic acid, and the same quantity of the twenty-grain nitrate of silver solution; pour the solution from the plate and mix it well with this and return it; in a few seconds the image will come out, but the solution must be kept in motion or the development will take place in patches, especially in the high lights, which no after treatment can remedy. The details being well out, pour off the developer: wash gently, and remove the iodide of silver with a weak solution of cyanide of potassium; again wash, and increase the intensity as in the former case.

Sometimes, when the negative is very weak, before this is done, the plate, after washing, may be treated with a solution of iodine, two drops of tincture to an ounce of water, and the negative be rendered much more capable of receiving a due amount of intensity without hazarding the film.

A salt of mercury also may be used; and the safest form that the writer has tried is that entered in his note-book as Robertson's, from Sutton's *Photographic Notes*, Oct. 15th, 1862.

Bichloride of mercury..... 4 grains.
Iodide of potassium.....11 „
Water..... 1 ounce.

Mix one part of the above with three of water. Fuming with ammonia, as well as the solution of carbonate of ammonia, recently recommended by Major Russell, has also been tried; but, however well they may suit plates otherwise prepared, in those above mentioned no increase of rapidity was gained in development, the film was weakened, and, in fact, the plates thus treated were spoiled.

Formic acid with pyrogallic acid, is a rapid developer; it not only loosens the film, but is peculiarly apt to develope in patches, and gives a wavy sky.

On the whole, the writer is convinced that, if a good negative can be produced by the simpler means proposed, it is far better not to resort to others which involve complicity of treatment; what is by some imagined to be a loss in this important stage is, in fact, a clear gain of time.

In all the additional artifices mentioned the film is endangered, and it will be prudent, after the prefatory development, to dry the plate and varnish the edges; indeed, this gives so little trouble, that it should be done in all cases when the manipulator only practises the art occasionally, before storing away the dry plate in the box. It is only necessary, whilst the plate is quite hot, to run a small camel's hair brush, dipped in varnish,

along the edge of the plate for one-eighth of an inch, holding the edge to be varnished slanting downwards, or it is apt to run into the film by capillary attraction. A very useful application of varnish deserves mention. After varnishing the edges, draw a thin line of varnish between the two pictures of an exposed stereoscopic plate after the first stage of development, taking care, of course, that the plate is thoroughly dry and warm; it sometimes happens that both pictures differ slightly in intensity, and thus, as the developing fluid confines itself within the varnish, we can develope one side more than the other, or, even, with a different developer. In the course of the very numerous experiments made with reference to the subject of this pamphlet, the writer has frequently had recourse to this device, with great economy of material and time.

The iodide of silver is removed from the plate by any of the usual means; but a weak solution of the cyanide of potassium is generally to be preferred. It is, of course, presumed that the development is complete, otherwise the details will be destroyed. In printing by development on dry glass plates, by superposition, the image may be brought out almost instantaneously by the usual pyrogallic acid developer, but often, on applying the cyanide solution, it entirely disappears, but is reproduced on applying a fresh quantity of developer; but no amount of silver will bring it up to the point of intensity required for a good negative. The same happens in the process of slow development if an attempt be made to push it before the deposit of silver within the film is in a condition prepared for this result.

The theory of this interesting subject does not come within the scope of this pamphlet, and it only now remains to give a summary of the respective capabilities of these methods, according to the writer's experience.

Process I. is an extremely certain process, and, if the directions given be followed out, can hardly disappoint the tourist. Any number of plates may be prepared at one time. They will keep for weeks, and need not be developed for some days after exposure; they require, however, almost as long an exposure as Fothergill plates. The preparation of the malt infusion demands care, and the operations are rather troublesome, which is no more than may be said of the other dry processes already in use; but the tourist will have no reason to complain if he arrive at the results which this method is capable of producing.

Process II.—This requires much less exposure than the preceding, especially if the slow development be employed. The plates seem to keep equally well with the last, but should be developed within a day or two of exposure.

Process III.—The tourist will most likely select this, as the preservative fluid is very readily prepared, and the plates may be coated during a journey: it is, also, far more sensitive than the last. The principal drawback to its use is, that the plates vary in sensitiveness with different kinds of glycerine. This can hardly be wondered at, as, in the manufacture of this fluid, which is now largely consumed, various accidents may occur, such as the presence of a minute portion of sulphuric acid, &c., which would unfit it for photo-

graphic purposes. The case has, however, thus been met by the writer:—Having, on trial, found a specimen which gave superior results, he obtained a sufficient quantity for his requirements: as glycerine costs a mere trifle, this is the safest plan. It would be well if the photographer could make all his own preparations, but this is clearly impossible. The matter is under investigation, and, when he has leisure, the writer hopes to fall upon a plan which will secure uniform results.

PROCESS IV. has only recently been tried, but promises to be a valuable addition to the photographer's resources.

In the text it should have been mentioned that if the negative after fixing be not dark enough, it may be intensified by any of the usual methods; of course, after fixing, it may be exposed to light for more thorough examination. Allusion has also been made in the text to different kinds of glycerine, as varying in their photographic properties; the same may be remarked of *tannin*, and the writer would recommend the use of tincture of galls, formed by digesting coarsely-powdered nut-galls in a mixture of equal volumes of absolute alcohol and water for three or four days. Half an ounce, by measure, of this tincture, with half an ounce of distilled water, one drachm of glycerine, and eight drops of glacial acetic acid, thoroughly mixed, form an excellent preservative fluid, and very convenient for the tourist whose stock of plates may be exhausted in a journey. It does not come within the object of this pamphlet to describe specific apparatus; one exception, however, may be admitted. Although it is desirable to prepare the plates at leisure, as recommended, occasions may arise in which they must be prepared at a short notice, and the drying may cause some embarrassment; the following little device meets the case:—Provide three pieces of perforated zinc plate, half an inch larger than the prepared plate; place one over the other in such a way that the holes do not coincide, and tack the corners together with solder; when the plate is well drained and surface dry, wipe the back carefully; place it on the above—sensitive surface, of course, upwards—and apply a spirit lamp beneath, moving about; the flame is divided, and the hot air well diffused, without danger of cracking the plate, with ordinary care.

SUPPLEMENTARY NOTICE
OF
PLANS USEFUL TO THE SCIENTIFIC TRAVELLER AND MISSIONARY.

THOSE who have interested themselves with the progress of photography, as recorded in the journals, must have observed one feature of advance at least in the far wider scope which has recently become recognised in the purposes to which it is capable of being applied, and a marked yielding of prejudice towards certain plans which, in the infancy of the art, were the ordinary means employed, but which, in proportion as photography limited itself to a narrower and more specific range of objects, yielded to methods more adapted to its requirements.

The all-engrossing subject of portrait taking seemed, at one time, to divert research from a more enlarged field and contract it to seeking out modes by which facilities, in the way of rapidity and economy, for this special object could be promoted, and its profits consequently increased. Those, however, who were capable of estimating the true nature of heliographic science perceived the boundless extent to which it might be applied, and were not slow in calling it into the service of almost every research which required the assistance of art to record its results, in the way of representative illustration. In most of these cases, however, it

is possible to avail ourselves of the acknowledged advantage of fixed apparatus, and, indeed, for many of the purposes alluded to, the utmost precision is demanded to attain the objects in view. In such cases also, the amount of detail required can only be met by the collodion process, which assumes a certain amount of material to be always at hand, and of such a nature that very slight causes affect its action.

There is, however, another class of cases in which, by having recourse to photography, we supply a want keenly felt by those whose duties or inclinations have placed them in positions where, from want of such assistance, most important facts have been left either altogether unrecorded or described without illustration in such a manner as to the reader can convey no adequate idea of the reality. It is true that the scientific traveller is almost of necessity capable of sketching from nature, or, at least, of making use of the *camera lucida*—a very valuable instrument, affording, with sufficient pains, any amount of detail—but both come far behind the requirements of those who are hurried for time, and are totally unfitted for taking such accurate delineations of evanescent objects as may be produced by the least efficient method in photography; and, admitting the great inferiority of such a method to the collodion process, in its present advanced state, in point of beauty and delicacy, it must be remembered that, in the case alluded to, the object is not so much to produce an attractive picture as faithfully to record a fact, and for this purpose, if he wish to attain his object, the traveller must resort to less perfect methods indeed but such as, with the slightest care

and the least possible inconvenience, will avail him for the purpose contemplated.

By those who take a narrow view of the matter it may be supposed that the specific duties attached to the office of a missionary also render an acquaintance with photographical operations of indifferent importance; but to every missionary circumstances must constantly arise, the record of which, if not useful to himself as a matter of reference, may, to others at a distance, be replete with interest, and conduce much to forward the objects he has in view. There is one point in which the missionary stands pre-eminently on vantage ground, and which gives his records, whether of description or pictorial, more than ordinary weight: he is, usually, no mere passing traveller, biassed with present impressions, and liable, though unintentionally, to give undue weight to incidental occurrences; but, dwelling sometimes for lengthened periods amongst the same people and in the same localities, is able to discriminate between what is normal, what only casual; and photography might by him be made largely to contribute to the extension of knowledge with respect to the nature of countries, their produce, and inhabitants.

It is clear, however, that his availing himself of this art must entirely depend upon its being adapted to the exigencies in which he is placed. The apparatus, for instance, must be light and compact, the materials few in number, and easily replaced. Now, these are conditions that are not complied with in the ordinary processes; and the object of the writer is to offer a few suggestions which he hopes will be found

to meet the case in point: and, at the outset, it must be kept in mind that we are supposing a case involving shifts, where it is not possible to employ the appliances for producing anything like a perfect picture, though desirable to retain as exact a *facsimile* of an object as the circumstances will admit of. Here, then, in the first place, size is no object, as from the smallest delineations we can increase dimensions to any desirable extent. The scientific traveller or missionary will not then burden himself with any photographic arrangements larger than those of a stereoscopic size. Again, he will confine himself to such surfaces for retaining an image as involve as little weight as possible; and he must, therefore, almost entirely discard the use of glass, and employ a lighter substance. Fifty plates of mica, for instance, large enough for his purpose, will weigh little more than half-an-ounce, whilst fifty plates of glass of the same size would weigh some pounds; but, as mica even can only be used to a limited extent, he will generally resort to paper, of which a single sheet, 22 by 17, may be made to receive twenty double stereoscopic pictures. Little room now remains for these hints, and the writer will confine himself to two methods useful for the purpose he contemplates, in the one of which mica* is used, in the other paper.

As the writer has made use of the largest sized mica plates which he could conveniently obtain—those adapted to a quarter size camera—he shall refer to these. It is obvious, however, that they may be cut down to any size.

* Of course, the writer is aware that mica is in use for various photographic purposes.

Let us suppose the operator to be placed in a position that will allow him to take half-a-dozen quarter glass plates on an expedition, but no more. These may be employed for hundreds of negatives on mica, which can easily be transmitted to a suitable place for copying on glass, and thus ensuring more durable negatives. The mica must first be attached to the glass plate with a weak solution of lukewarm gelatine: Major Russell's formula may be used for this purpose. The gelatine having been poured over the glass plate in the usual manner, and drained for a few seconds, place the mica plate neatly and gently upon it, which can easily be done without inclosing air bubbles, and dry the whole as usual; when dry, examine the surface of the mica by reflected light, and breathe upon it; if spots appear, these can be removed by wiping with a soft wash leather, scrupulously prepared for the purpose, and it must be remembered that mica is easily scratched. When convinced of its cleanliness, collodion is poured on, in the usual manner, over the whole surface, both of mica and glass—the latter being larger than the other, and projecting beyond the edges; sensitise in the bath and proceed precisely as above directed for glass plates, using in preference Process III., and in every other respect to the final varnishing* of the picture as

* Varnish may not be at hand; the white of egg, diluted with half its bulk of water, may be substituted, drying in the sun or by artificial heat, and carefully avoiding air-bubbles. It appears, on the authority of Dr. Livingstone, that the white of the egg of the crocodile is not coagulable, and the photographic traveller may find it valuable in some of the albumen processes; at any rate, it is a fluid well deserving examination in a chemical point of view, and the writer would be proud to undertake its analysis. It might be smeared over any glazed surface, evaporated in the sun, and then collected as a gummy mass, when it would be little liable to decomposition.

in the other dry processes. When all is finished, pass the point of a penknife round the outside edge of the mica, and soak the plate for a minute or two in lukewarm water, when the mica is to be carefully removed from the glass plate, which may now be washed and prepared for another journey. Many other methods may be used for attaching the mica, such as a drop of collodion, &c.; but the writer prefers the method proposed.

It may not, however, be possible to make use of the collodion at all, the stock of materials being exhausted, and we fall back upon paper. Any person who has followed up the calotype process on the plan laid down by Mr. Sutton, in an admirable little work on this subject, published some years ago, will practice the following with ease and success.

The paper used by the writer for this purpose is Hollingworth's negative. Many others have been tried, but those sized with vegetable matter give comparatively weak negatives. Instead of merely coating the surface of the paper with potassio-iodide of silver—which, for this purpose, need not be half the strength of that used for the ordinary Talbotype—it is plunged into the solution and allowed to soak for five minutes, when it is removed and suspended by a clip, with a strip of blotting-paper at the corner, to dry; proceeding in a similar manner with the remaining sheets. A considerable amount of paper can thus be prepared at the same time. When dry, the excess of iodide of potassium must be washed out, and the iodide of silver precipitated on and within the paper, as usual, omitting none of the precautions necessary in this important stage. When thoroughly washed, the paper is again

dried and stored for use. In preparing for impression, make a solution of—

Tannic acid	5	grains.
Alcohol	2	drachms.
Water	6	„
Glacial acetic acid	10	drops.
Solution of nitrate of silver	5	„

Twenty grains to the ounce of distilled water. Mix thoroughly, all this portion of the operation being performed where not a particle of white light can enter. The paper is brushed over with this, in the usual manner, excess of fluid removed with blotting paper, and the sensitised paper folded over the glass plate—sensitised surface outwards—and attached to the back by means of gum or other suitable adhesive fluid. The further manipulation is the same as for the Talbotype, but the paper is far more sensitive and gives a much denser negative. One minute and a-half to two minutes, with a stereoscopic lens and small aperture, is sufficient. The glass plates on which the paper is stretched may, of course, be re-employed to any extent; and for this purpose varnished pasteboard or ebonite may be substituted for glass with advantage.

This paper will be found a most useful travelling companion in another way. It may be convenient to take an average number of dry glass plates on a tour, but not at all sufficient for the objects contemplated. Then print on this paper, by development, and from this positive, at any future time, other negatives may be produced on glass or paper; the original glass can then be washed and prepared for fresh views, keeping, however, a few of the prepared plates for the choicest

objects. With care on the part of the operator, a great number of useful negatives may thus be obtained in very inaccessible places, nor need he be discouraged at the inferiority of his results, under the emergencies we suppose, with the indifferent means he is obliged to employ. The class of objects which he has placed on record are of no ordinary interest or every-day character, and will amply repay the application of various artifices known to the practical intelligent photographer, who, with the most jealous regard to the truthful reproduction of the originals, will be able to correct any accidental blemishes inseparable from the very circumstances under which they were obtained.

Quite recently another modification of the calotype process has been recommended by Mr. Prichard,* and promises many advantages to the tourist, especially from the circumstance of its reducing the operations to the simplest conditions; in fact, nothing more is necessary than preparing the calotype paper in the usual manner with the greatest possible care. This may be done in the light at any convenient time, and in quantities sufficient to last for months; so that a stock may always be ready. We have now then merely to sensitise for use, with a moderately weak solution of nitrate of silver, in the dark, washing off the solution from the surface, and drying between folds of bibulous paper. Of course, if the sensitised paper is not to be used for some hours, the washing will be attended to with greater care. The writer has only had leisure to make a few experiments on the subject, and had not at hand Turner's paper, as recommended by Mr. Prichard;

*The British Journal of Photography, May 15th, page 203; and June 1st, page 241, of the present year.

but Hollingworth's paper, saturated with potassio-iodide of silver, as above recommended, answers admirably—the little black spots excepted—and, although it is not so sensitive as when the solution of tannin is used, it keeps longer and developes with greater cleanness in the lighter parts of the negative.

Whatever paper plan be used, it is important to wash very thoroughly when the development is completed; and this operation is best effected by pressing the negative between folds of bibulous paper after each washing.

Those who have practised the paper processes must have been frequently annoyed by the negative losing much of its density in the hyposulphite bath. The writer has tried the sulphocyanide of ammonium, which certainly is safer; but its present high price is prohibitory to most amateurs: nor is it necessary to remove the iodide of silver at all, as the application of a weak solution of iodide of potassium after the last washing is all that is required. The negative may then be dried and waxed as usual, the slightly primrose tint of the remaining iodide of silver being far less resistant to light than the brownish colour that is so apt to occur after treatment with hyposulphite of soda.

It has not been considered necessary to describe the manipulatory steps more minutely; nor would it be possible to do so in a few words without obscurity. Many special manuals have been devoted to the subject, amongst which Mr. Sutton's handbook, published in 1856, stands pre-eminent; and, by following the directions therein given, the experimentalist cannot fail to obtain the best results of which this paper process is capable. The wax-paper and other methods

have not been mentioned, as the risks and inconveniences attending their use are not less than those of the collodion process, and, therefore, little suited to the tourist in extreme cases. We must, however, allude to the addition of bromine and its compounds, in connexion with the iodides, as a means of producing the sensitive surface; and on this subject the writer can speak with some confidence, having made it a special matter of inquiry. He believes, then, that the iodide of silver *alone* is best adapted to the purpose contemplated in this Appendix. In the first place, it is simpler—a most important consideration, to which many a trifling advantage must be sacrificed; in the next place, the time of exposure with iodide of silver alone is not a matter of much nicety, whereas, with the addition of bromide of silver, if the paper be over-exposed to any great extent the lighter shades and whites of the negative will almost certainly be destroyed during the development. By following Mr. Sutton's very lucid instructions on this stage of the operations, the paper, merely iodised, may be exposed several times as long as necessary for impressing an image; indeed, when the traveller has but one chance of securing an object, over-exposure should always be risked. When the writer practised the wax-paper process, success was just in proportion to the simplicity of the iodising mixture; and the addition of excess of bromides, fluorides, cyanides, chlorides, and especially sugar of milk, as recommended, led to inferior results or loss of negative.

The washing-out of the excess of iodide of potassium, which must be done very thoroughly, has frequently been considered a great objection to this

method; but this may be accomplished in a much shorter time, and with considerably less water, if the following course be pursued:—The paper, having been saturated with the potassio-iodide of silver, and thoroughly dried, is to be plunged in a dish of distilled or rain water, frequently turning it, and each time passing a feather over the surfaces to remove minute bubbles; it may then soak for five minutes, when it is removed and hung up with a *clip* to drain. Whilst this is going on another sheet is treated in a similar manner, and so on with the whole quantity to be prepared. The water is now changed for a fresh supply, and, beginning with the first sheet, the whole series is proceeded with as before; and, after thus washing three times, the papers may be finally dried. With two or three dishes, a large quantity may thus be prepared in an hour.

As the pores of the paper are thoroughly saturated with the silver solution, it has been mentioned that it is unnecessary to use it so concentrated as when one surface only is iodised.

From the above remarks, then, it will be seen that the materials required for photographic representations, under the difficult circumstances we have supposed, are few in number, light, and occupy but inconsiderable space. As to the manipulations, any person with far less handiness than those to whom our observations are applicable may become an adept after a few days' practice; and, as to apparatus, the objective of the travelling telescope may be used for a lens, and a few pieces of thick pasteboard be easily converted into a dark box. Many other hints suggest themselves, but time and space prohibit further details.

LIVERPOOL:
HENRY GREENWOOD, PRINTER, CASTLE STREET.